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Determining the value of multiple ecosystem services in terms of community wellbeing: Who should be the valuing agent?

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ABSTRACT

When multiple ecosystem services are derived from multiple ecosystems across different policy, planning or management jurisdictions, questions arise regarding the valuation of ecosystem services such as: who are the beneficiaries; how do they value ecosystem services; and who should be the valuing agent? In attempting to achieve an integrated approach to natural resource management in South East Queensland (SEQ), stakeholders have combined their knowledge to develop a framework to identify, measure and value ecosystem services provided by the region. This paper focuses on a methodology trialled to value the ecosystem services derived from the SEQ region in terms of the wellbeing of the SEQ community. The methodology allows flexibility of choice regarding whose values count and who should be the valuing agent. The methodology was trialled with community participants and scientific experts. The building blocks of the Framework can be used to construct different model variants, each of which reveals key characteristics of ecosystem services in SEQ. The approach adopted to value ecosystems and ecosystem services offers scope for decision makers to think more broadly about possible impacts of decisions on the wellbeing of the community and has facilitated the inclusion of ecosystem services in statutory planning policy in SEQ.

1. Introduction

Identifying the ecosystem services provided by a region and assessing their contribution to human wellbeing is a daunting task. It requires application of complex systems theory, as it typically involves an analysis of the many diverse, autonomous, interrelated and interdependent components of socio-ecological systems (Limburg et al., 2002; Stratton, 2005). The relationships between a given ecosystem, the multiple services it provides and human wellbeing are complicated (de Groot et al., 2002; Fisher et al., 2009; Maynard et al., 2010). Research to date has therefore focused mostly on the services provided by a single ecosystem (Campbell and McKenzie, 2004; Ricketts et al., 2004) or only a few ecosystem services simultaneously (Chan et al., 2006; Egoh et al., 2008; Naidoo et al., 2008; Willemen et al., 2008). A greater challenge is faced when attempting to develop and apply tools that can consistently and comprehensively account for the full range of ecosystems and ecosystem services derived from a region; and support the diverse decision-making and functions of multiple agencies, such as statutory planning, community planning, water management, nature conservation and community education.

The Millennium Ecosystem Assessment (MA, 2005) suggests that, to make ethical and informed policy, planning and management decisions, the full range of ecosystems and ecosystem services should be assessed. For example, the MA identifies twenty-four ecosystem services derived from ten Reporting Categories (biome groups), providing an assessment of the full range of ecosystems and services for the whole planet. Costanza et al. (2011, p. 2) advocate this approach, stating 'the full range of ecosystem services must be considered to prevent creating dysfunctional incentives and to maximize net benefits to society'. To mainstream ecosystem services in decision-making processes, effective approaches are required to demonstrate the value of maintaining and/or enhancing different ecosystems in terms of their importance to the wellbeing of generations, in the context of competing stakeholder interests (Cowling et al., 2008; MA, 2005; Smith et al., 2013).

When multiple ecosystem services are derived from many types of ecosystems across different policy, planning or management jurisdictions, fundamental questions underpinning the valuation of ecosystem services arise such as: who are the beneficiaries; how do they value ecosystem services; and who should be the valuing agent? Additional questions are: what kind of analytical frameworks should be developed in demonstrating the inter-connections between ecosystem services and beneficiaries; how might such a framework best be developed; and how might the relevant supporting data be obtained?

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The South East Queensland (SEQ) region is approximately 23,000 km^2. It is one of the fastest growing regions in Australia with the current population of around 3.4 million predicted to grow to 4 million by the early 2030s (Department of Environment and Resource Management, 2009; Office of Economic and Statistical Research, 2012, p. 17). The region has a rich variety of ecosystems and is a recognized Australian Government 'biodiversity hotspot' (Department of Environment and Resource Management, 2009; Department of Environment, 2013). Collating the information required for a comprehensive assessment of the multiple ecosystem services provided by the SEQ region is accordingly a major challenge.

Since 2005, work has progressed under the SEQ Ecosystem Services Project on developing, refining and applying an ecosystem services framework (the Framework) to meet the multiple objectives of planning, environment protection and natural resource management in the region. The Project is coordinated by SEQ Catchments, an independent body recognised by the Australian Government, responsible for facilitating projects and programmes for natural resource management in SEQ (Australian Government, 2011). The Project was designed specifically to engage stakeholders and potential users in developing the Framework. Those involved have included representatives of government and non-government agencies, business, industry, academia and the general community.

This paper describes the way in which the Framework was developed, its main components and general structure, some results from its application, and an evaluation of the methodology adopted to value ecosystem services derived from the SEQ region in terms of the wellbeing of the SEQ community.

2. The SEQ Methodology

An innovative approach to developing the Framework was adopted, similar to that used in collaborative planning (Healey, 2003, 2005), Bayesian networks (Neapolitan, 1988; Pearl, 2009), participatory systems analysis (Smith et al., 2007) and decision support systems (Janssen, 1992). Such models create opportunities for stakeholders and experts to be actively involved in the processes of model construction and application, as well as handling inter-relationships in the simplest possible way, including making use of quantitative and qualitative data. Participation by stakeholders in assessing ecosystem services has been recommended by many, such as the MA (2005), van den Hove (2000), Reid (2006), Cowling et al. (2008), Liu et al. (2013) among others. The SEQ Project was deliberately designed to encourage participants to acquire a sense of ownership of the Framework and, through its development, gain a better understanding of the requirements for better managing ecosystem services in the region (Maynard et al., 2012).

2.1. Participatory Processes

Stakeholders in the Project participated in various ways. General directions for developing the Framework were established by a Steering Group, comprised mainly of potential key users of the Framework and/or funders of the Project. Facilitated workshops were staged to report on progress and seek input from a broader group of stakeholders. To cover scientific aspects of the Framework, Scientific Expert Panels were formed, comprising individuals with expertise in the physical and biological sciences. A Socio-Economics Expert Panel contained individuals with expertise in social sciences and economics. Multidisciplinary Expert Panels brought these experts together. Data to populate the Framework was provided by Working Groups within the Expert Panels. Each Working Group concentrated on a particular aspect of the Framework, as described further in Section 2.2. Experts were selected on the basis of their experience and published works and were well-recognised by peers in their specialist fields Mostly they resided in SEQ, with detailed knowledge of the region and its natural or socio-economic features. In all, more than 190 individuals participated in the project. Further details of the participatory processes adopted are described by Maynard et al. (2010, 2012).

2.2. General Structure of the Framework

Participants overwhelmingly recommended using the Millennium Ecosystem Assessment (MA) as the basis for the SEQ Framework. However, some modifications of the MA framework were introduced. Experts involved in the process considered that many of the services in the MA were ecological processes or ecosystem functions rather than ecosystem services. In the SEQ Framework, ecosystem functions are recognised as being necessary for maintaining ecosystems and biodiversity for its own sake (Maynard et al., 2010; Petter et al., 2012). Whether ecosystem functions contribute to service provision depends on many factors, such as the extent of the function, location of people and the importance that people place on different services (Maynard et al., 2010). The schema advocated by de Groot et al. (2002) was instrumental in developing the final list of ecosystem functions adopted for the Framework, but it was appropriately amended to suit the SEQ region. To avoid the problem of double counting in ecosystem valuation – a key issue highlighted by Haines-Young and Potschin (2010), The Economics of Ecosystems and Biodiversity (2010) and the UK National Ecosystem Assessment (2011) among others – only the MA service categories of Provisioning, Regulating and Cultural were adopted for the Framework.

The Framework identifies four main components of an ecosystem service assessment: ecosystems, ecosystem functions, ecosystem services and constituents of wellbeing (Maynard et al., 2010):

Ecosystem Reporting Categories (ERCs) — 32 groups of ecosystems, each ecosystem within a group having similarities in climatic conditions, geophysical condition, dominant use by humans, surface cover, species composition and resource management systems and institutions;
Ecosystem Functions — 19 biological, geochemical and physical processes and components that take place or occur within an ecosystem;
Ecosystem Services — 28 goods and services provided by natural (and semi-natural) ecosystems that benefit, sustain and support the wellbeing of people;
Constituents of Wellbeing (COWB) — 15 aspects of human wellbeing that are improved through the use of ecosystem services or the knowledge that these services exist.

Fig. 1 displays the four main components, and a full listing of all categories appears in Table 1. Inter-connections between the components are represented by a set of linked matrices and vectors, with elements in the form of scores indicating the relative magnitudes of the interconnections, as well as scores representing relative value weights for ecosystem services or COWB. The various matrices and vectors act as building blocks to construct different assessment models, as well as revealing important properties of the system.

The Framework includes a detailed GIS database able to produce a wide range of maps indicating the spatial distribution of ecosystems and functions important for the provision of different ecosystem services and human wellbeing. Information on the spatial characteristics of the region is critical for land-use planning, the design of offset programmes, and investments aimed at protecting or enhancing natural assets. Details of mapping capabilities, procedures and applications of the GIS as an integral aspect of the Framework are described by Petter et al. (2012) and are on the Framework's website (SEQ Catchments, 2013).

2.3. Expert Scores for Ecosystems, Functions and Services

The algebraic notation, dimensions and sources of data to populate the matrices and vectors in Fig. 1 are presented in Table 2. The matrix **E** was constructed by biological and physical science experts, divided into small Working Groups, each concentrating on a subset of ecosystem